The temperature mounted rapidly throughout the forenoon, and it appeared that the highest readings of the season would be recorded.

At 9:45 a. m. cumulus clouds were first observed in the northwest, drifting slowly from the WNW. At this time, the surface wind was shifting between W. and NW., with moderate velocities.

A second pilot balloon observation was made at 1:09 p. m., which indicated a backing of the wind from NE. at the surface, through N., NNW., NW., WNW., becoming W. at 6,000 feet. The velocities were low and increased only slightly with altitude, being but 17 miles per hour at 7,000 feet. At this time, large towering thunderheads could be seen moving upon the station from the NW., while others appeared to be passing some distance to the north.

The seeming assurance, which a digest of the above observations gave, of encountering all the adverse conditions incident to piloting a balloon through thunderstorms, was weighed. Also the possibility of danger from lightning was considered. However, the enthusiasm of the pilot and observers would not be denied and the balloon left the ground at 1:59 p. m.

True to the results obtained from the pilot balloon observation, we drifted off to the southward, and, with rapidly gaining altitude, moved slowly into the SSE. At the end of the first five minutes, an altitude of 2,000 feet had been reached. The temperature here had fallen from 31.3° C. at the surface, to 28.2° C. The atmosphere was very hazy to the south and southwest, while showers were observed a short distance to the north-northwest. At 2:09 p. m. an altitude of 2,340 feet had been reached and we were nearing the edge of the Chesapeake Bay. The sun was obscured and the balloon was under a heavy cumulus cloud. Difficulty was being experienced in gaining altitude, due to contraction. Thunder was first heard in the north at 2:12 p. m. At this time, it was thought best to go above the clouds to lessen the danger from lightning and, also, to endeavor to strike the westerly wind with greater velocity. The absence of sunshine, however, made this operation difficult, and required the expenditure of much ballast. At 2:14 p. m., an altitude of 2,900 feet had been reached, and we were going more nearly southeastward and approaching close to the edge of the bay. The thunder was sounding nearer and the rain appeared almost upon us. During the next several minutes, while over the bay, and with the sun hidden, constant difficulty was being met in maintaining altitude. At 2:44 p. m., we had fallen to 2,000 feet, and were over the bay and opposite the mouth of the Sassafras River. At this point, rain was heard striking the balloon. At 2:49 p. m. we were down to 1,100 feet and had moved inland south of the river. Ballast was used freely here and we began rising rapidly. The rain had stopped for a short time, but at the next observation we were in the midst of a large Cu.Nb. cloud and the rain was beating down hard. Thunder was plainly heard, although no lightning was observed. We had lost sight of the ground and were still rising rapidly. It appeared as though our position within the cloud was operating to accelerate the already rapid ascent. The vertical movements of cloud sections were readily discernible. At 3:04 p. m. we had reached 5,220 feet and appeared now to be at the edge of the cloud. Towering above us many hundred feet, we could see the great thunderheads still piling upward.

Some openings appeared above us revealing the presence of a layer of thunderstorm cirrus. The sun was now shining on the balloon, sending us still higher. The temperature while within the cloud had been down to 19.4° C. This now rose rapidly to 28.0° C., due both to direct sunlight and to that reflected from the clouds beside us. At this point our attention was attracted by moderate sized hailstones passing down past the balloon. The observation of this phenomenon would seem to agree with the theory of the formation of hailstones, which provides for their formation in the upper portions of the Cu.Nb. in preference to the theory for their formation in the squall cloud. Certainly this observation was made at a considerable distance above the level of the squall cloud; also, the temperature observations would preclude the possibility of hailstones forming at this or lower altitudes. Undoubtedly, the hail which we observed was issuing from the cloud a considerable distance above the balloon.

We were still gaining altitude at 3:09 p. m. and had encountered a moderate northwest wind which was carrying the balloon inland. About 3:22 p. m. the balloon reached the maximum altitude of the flight—8,200 feet. Shortly after this we were again within the cloud. Loud thunder was heard and it was raining hard. We now began to descend rapidly. At 3:34 p. m. we were down to 4,850 feet and still falling. Much ballast was expended in an effort to check the descent, but due to the rain and gas contraction we were unable to establish an equilibrium. We were now drifting toward a wooded ravine and a good landing did not appear possible. Our ballast was being rapidly depleted, but with only momentary relief from the unwelcome proximity to tree tops. By this time the drag rope was catching in the branches, sometimes stopping the balloon for a minute or two. From the basket the balloon now gave somewhat the appearance of a parachute. This, added to our lack of ballast, prevented our escape from this position. After each freeing of the drag rope the balloon only drifted farther down the ravine, until finally the rope became securely entangled in the top branches and held us fast. There was very little wind movement at this time and we were prevented from settling in the trees only by grasping the top branches in our hands and holding our balloon up.

We were soon rescued, however, by several farm hands, summoned from a nearby road, who cut the drag rope from the tree. We then drifted to the edge of the wooded area and valved down in the corner of a grass field, about 3 miles west-northwest of Kennedyville, Md., being an air-line distance of about 30 miles from the starting point.

Thus ended what was agreed upon by all participants as a balloon flight crowded with interesting observations and experiences.

The balloon was piloted by First Lieut. H. H. Holland, while Maj. J. C. McDonald and Second Lieuts. E. C. Cooke and Don McNeal were the observers.

EFFECT OF WEATHER ON THE AERIAL MAIL SERVICE.

Interesting notes regarding the reliability of the aerial mail service have appeared in the *Aerial Age Weekly* and the *U. S. Air Service*. In its issue of April 5, 1920, the former presents a report for the eight months preceding April. Among other points mentioned in the report is the number of forced landings on account of weather conditions. During this period there were 1,111 trips with a total of 203 forced landings, of which 47 were attributable to mechanical trouble and 154 to the weather. The latter magazine (July, 1920) reports for the month of May for routes between New York and Washington, New York and Cleveland, Cleveland and Chicago, Chicago and Omaha. In all, 54,693 miles were flown. Two forced landings were made on account of mechanical troubles, fifteen because of running out of oil or gas in combating head winds, four on account of bad weather, and seven because of the lack of familiarity of new pilots with the course. In the eight-month report 75 per cent of the forced landings are attributable to the weather, and for the month of May 68 per cent. While it is true that the actual number of forced landings is small, considering the number of miles flown and the rigorous schedule which is maintained by the mail service, nevertheless, these reports emphasize the dependence of the aviator upon weather conditions.—*C. L. M.*

DAYTIME WIND TURBULENCE IN A MOUNTAIN VALLEY.

By B. M. VARNEY.

[University of California, July 15, 1920.]

SYNOPSIS.

An unusual example of wind turbulence in the daytime air stream in mountain valleys is found near Yosemite Valley, Calif. The stream as it flows east up the valley in the afternoon divides through two branch canyons, the current in the southeasterly branch turning sharply round a steep mountain spur. This spur and the configuration of the canyon walls sets up a rotation of air in the lee of the cliffs about an inclined axis, the lower end of which is at the spur, the upper end about a mile away to the east, the general trend being parallel to the side of the canyon. The path of an air particle near the periphery of this roll was found, by observations on the drift of tissue papers, to be that of a great spiral, the diameter of which seems to vary from nothing at the spur to perhaps 2,000 feet at the east end. Observed variations in the form of the spiral are due to changes in the local winds under the influence of topography.

Paper pie plates do not ordinarily lead to even casual studies of winds in mountain valleys. They are not commonly thought of as anemoscopes. In Yosemite Valley, Calif., in the early afternoon of June 8, 1920, however, a certain pie plate, having presumably functioned in the manner common to pie plates, suddenly and under circumstances unknown to the writer, assumed the rôle of an anemoscope and led to an hour's most interesting study and to the discovery of a wind phenomenon not hitherto observed by the writer.

Yosemite Valley, trending in a general east-west direction, branches at its upper eastern end into two valleys, Tenaya Canyon toward the east-northeast and the canyon of the Merced River leading by two right-angled turns, first south a half mile and then east a mile up a steepish gradient to Little Yosemite Valley, which penetrates the Sierra Nevadas in a general east-southeast direction. Between the two branches stands a mountain mass of which Half Dome, 4,892 feet above the main valley floor, is the dominating feature. The daytime stream of air up the Yosemite Valley, of course, splits against this mountain mass, the stream into the Little Yosemite being forced through the narrow and crooked canyon of the Merced River. At the second turning (south to east) the stream passes round a sharp and steep spur which stands like a slanting door post in the reentrant angle of the canyon, and past which the wind on clear, warm summer days often whistles with gale force. This sudden turn, together with the configuration of the corner as noted, appears to be responsible for the extraordinary turbulence to be described.

The writer was on a jutting point on the spur some eleven hundred feet above the valley floor, from which point the accompanying eastward-looking sketch was made, when suddenly a paper pie plate came swirling up from below in a vertical suction current in the lee of the spur. In a twinkling the rushing current aloft, turning round the mountain spur, caught the plate and hustled it off upward and eastward. Thus began the flight. It was easily traced, first with the gray cliffs as background and then a clear sky. Presently the plate began to draw away from the cliffs, rose, and describing a gigantic arc toward the middle of the valley, finally got into a downward rush at a speed far too great to be due to the simple action of gravity on the plate in still air. This looked like the end of the flight. When, however, the plate seemed about to be lost in the forest at the bottom, its flight gradually turned into a rush at high speed over the tree tops eastward up the valley, then into an ascent toward the north valley wall, then into another swirl aloft close to the rocks, like the first, another drawing out over the valley, another descent until again it seemed as if the flying plate must "crash," but then another run up the valley as before, turning again into a flight upward along the rock wall and ending out of sight behind a mountain spur nearly a mile away (Mt. Broderick in the sketch).

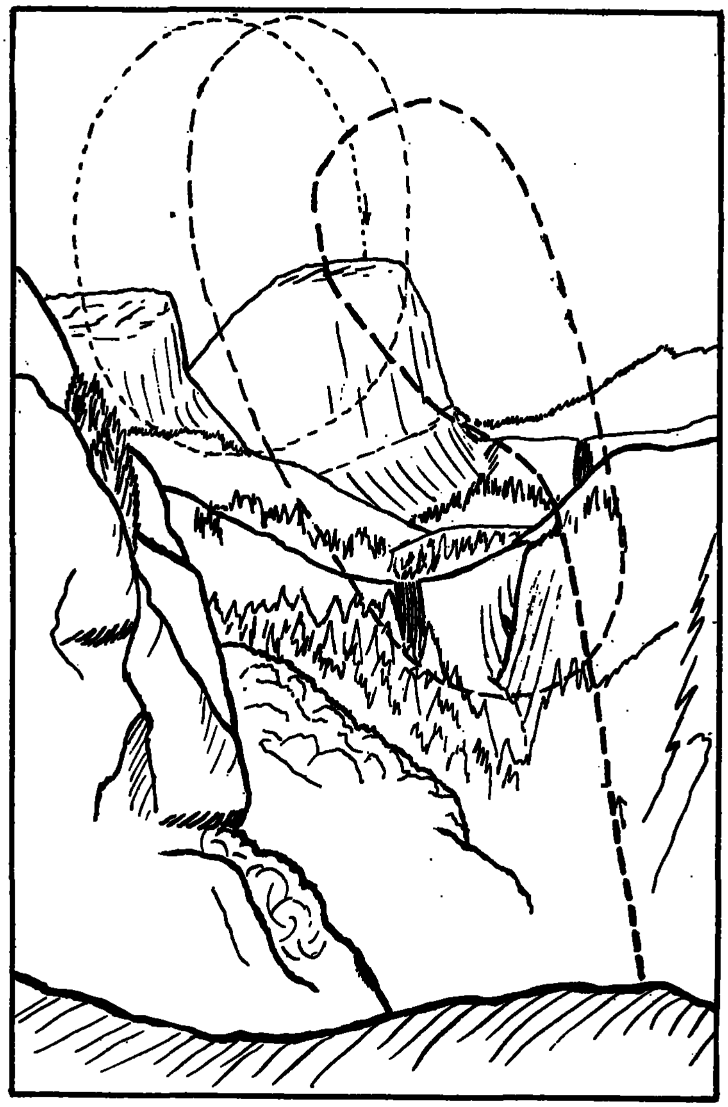

FIG. 1.—Path of paper-flight observed from Sierra Point, Yosemite National Park, early afternoon of June 8, 1920, looking east. North side of canyon of Merced River on left. Vernal Falls in middle distance, $\frac{1}{2}$ mile away. West face of Mount Broderick, left distance, $\frac{8}{10}$ mile. Nevada Falls (right), $1\frac{1}{10}$ miles. Summit of Liberty Cap, $1\frac{1}{10}$ miles. The top of the first turn in the spiral, estimated to be about 500 feet above point of observation; top of last turn, over Liberty Cap, estimated at about 2,500 to 3,000 feet (the latter estimate being based on the fact that the summit of Liberty Cap is 1,600 feet above Sierra Point, and that the face of the sheer cliff extends about 1,300 feet below the summit). Sketched from a photograph taken by the writer.